United Nations Industrial Development Organization

Distr.
LIMITED

ID/WG.440/7
7 May 1985

ENGLISH
Original : SPANISH

Regional Meeting for the Initiation of
a Regional Network for Microelectronics
in the ECLAC Region (REMLAC)*

Caracas, Venezuela, 3-7 June 1985

GOVERNMENT POLICIES FOR THE DATA PROCESSING INDUSTRIES IN ARGENTINA, BRAZIL AND MEXICO**

prepared by

Hugo Nochteff***

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* Co-sponsored by SELA/ECLAC

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*** Professor, Latin-American Faculty of Social Sciences (FLACSO), Buenos Aires, Argentina.

V.85-25734 (EX)

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1. INTRODUCTION

1.1. THE ELECTRONICS COMPLEX AND THE ROLE OF THE STATE

1.1.1. The electronics complex

The development of the "electronics complex" (EC) or of the "data processing technologies" has a fundamental influence on the dynamics of the world economy and on the intrinsic configuration of the pattern of accumulation at international level[1].

The specific nature of this technologico-industrial complex has been summarised by the statement that all the activities (mechanical or intellectual) presuppose some form of information interchange, and that these technologies have created a system which is universally applicable to the processing of information[2].

What is decisive in any explanation of the importance and dynamics of the EC is that these technologies make it possible - in those companies and countries which operate and develop them - to accelerate the process of capital accumulation by three simultaneous routes :

- Firstly from the results which can be obtained in regard to reductions in costs and in the creation or extension of markets;
- Secondly since this development is a means of reinforcing and accelerating the steady trend towards independence of "external" conditions in the process of capital accumulation, basing it on natural resources and the national labour force;
- Thirdly because state policies in the industrialised countries - and in some of the developing countries - accelerate the development of the EC, so absorbing a large part of the costs of its growth.

1.1.2. The role of public policies

The role of the State has been a central one in the configuration, trends and dynamic of the EC. If it cannot be stated that public policies have been a direct "cause" of the development of the EC it is nevertheless clear that the latter is not the natural result of the free development of

1. See OECD. Interfutures. Final Report, Paris, 1979.
2. See Rada, J. The impact of microelectronics. ILO, Geneva, 1980.

market forces. The basic concept underpinning governmental policies for the promotion of the computer industry (as a part of the EC) arises from the need to provide support to those areas where development cannot be left to the natural dynamic of the market[1].

In all the industrialised countries the State has devoted huge resources (both economic and institutional) in order to absorb the private costs of research and development (R & D) and in order to reduce company risk. The policies utilised for this are often quite distinct, depending on the political and economic structures of the countries concerned, the involvement of each of them in the international economy and their relative standing in regard to the EC technologies and industries.

Some of the principal political instruments which have been used - in various proportions depending on the countries concerned - are : financial and fiscal promotion, the direct and indirect public financing of R & D, explicit or implicit market reservations, tariff and extra-tariff protection, planning, direct State participation in capital investment, State purchasing guarantees or preferences for domestic companies in such purchasing, etc.

1.2. THE LATIN-AMERICAN SITUATION

1.2.1. The electronics and data processing complex in the region. General observations and common problems.

The incorporation within the region of those goods and technologies included within the EC (including data processing services and goods) appears to be a heterogeneous, discontinuous and disordered process.

The offer has developed on the basis of fundamentally exogenous impulses[2]. On the one hand there are those coming directly from the international market, through imports and direct foreign investment (DFI). On the other hand there are those coming indirectly from national responses to the development of the world market. In general, and apart from some relatively recent and partial exceptions, these responses have been limited to the replacement of

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1. After Sozaburu Okamatsu, Director of Electronics Policy of the MITI, in the Journal of Japanese Trade and Industry, March 1982.

2. After Lahera, E. and Nochteff, H. La microelectrónica y el desarrollo Latinoamericano, in Revista de la CEPAL. Santiago de Chile, April 1983.

imports which has characterised Latin-American industrialisation in recent decades[1].

The limitations and inadequacies of this type of development, which has been reproduced in the field of regional data processing and electronics, have resulted in :

- The generation of an imitative pattern of accumulation which is not suited to the economic and social needs of the region;
- Orientation towards domestic markets, with an inability to export;
- The predominance of consumer goods production, a barely integrated industrial profile and serious deficits in the production of capital and intermediate goods;
- The marked predominance of multinationals in the most dynamic areas, especially in regard to exports;
- Increasing external deficits in the interchange of goods;
- Limited intrinsic capabilities for technological development and technical backwardness, linked to a productive apparatus orientated towards replacing imports in respect of product ranges and processes involving well-established technologies;
- The exclusion of vast sectors of society who do not benefit from an industrialisation directed towards meeting needs related to other types of societies.

In addition the replacement path involves a style of public policy slanted towards the utilisation of general external trading instruments and some specific policies for the development of capital investments in sectors involving well-established technologies.

Such an orientation - coupled with the already mentioned industrial structure - results in an administrative system with a limited perception of the need for policies such as those described in paragraph 1.1.2., and in serious weaknesses in their formulation and implementation.

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1. See Fajnzylber, F. La industrialización trunca de América Latina, Nueva Imagen, Mexico, 1983.

1.2.2. The EC in the region

Within the general framework which is common to the countries in the region significant differences may be seen in local production capacities and in the incorporation of data processing services and goods.

These differences may be seen even in the distribution of conventional communications services, such as telephones (see Table 1 below).

Table 1 Density of telephones per 100 inhabitants, 1982

Country	Number
Argentina	9.3
Brazil	6.3
Mexico	7.2
Rest of Latin America*	4.9

Source : UNCTAD STATISTICAL POCKET BOOK, United Nations, TAD/INF/PUB/84.4 New York, 1984.

* Mean for 15 countries, excluding Argentina, Brazil and Mexico.

Table 2 makes it possible to compare the differences in the number of computers per 1000 inhabitants in the countries of the region[1]. It may be seen that this indicator of the penetration of data processing services and goods is positively correlated with the economic and demographic indicators set out in the same table, whether it is the per capita GNP, the level of industrialisation or the degree of urbanisation[2].

Another factor which has to be taken into account is the fact that some Latin-American countries represent dynamic markets, of interest to the major world producers. As may be seen from Table 3 six of these countries are listed amongst the fifty largest importers of computers in the world.

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1. Due to differences between the national methods for classifying computers the number of physical units has been taken as the indicator. This may produce distortions if there are major differences in the composition of the respective numbers of installations.

2. Pearson's correlation coefficient 'r' gives the following values between the number of computers and the per capita GNP, level of industrialisation and the degree of urbanisation : +0.87, +0.69 and +0.77 respecively.

Table 2 Total number of computers in Latin America - Comparison with economic and demographic data, 1982

Country	Total number of computers (units)	Computers per 1000 inhabitants	Per capita GNP (US$)	Level of industrialisation (%)	Degree of urbanisation (%)
Argentina	28,174	0.411	2,520	35	83
Bolivia	5,721	0.015	570	27	45
Brazil	120,507	0.154	2,240	32	69
Chile	11,292	0.106	2,210	34	82
Colombia	26,425	0.090	1,460	31	65
Costa Rica	2,341	0.106	1,430	27	43
Honduras	3,818	0.026	660	27	37
Jamaica	2,194	0.075	1,330	32	48
Mexico	71,215	0.141	2,270	38	68
Paraguay	3,057	0.114	1,610	26	40
Uruguay	2,929	0.366	2,650	33	84
Venezuela	15,423	0.482	4,140	42	84

Source : Calculated on the basis of: Katz, Raúl L. Data Service Industries in Latin America, Buenos Aires, 1984 (duplicated); International Monetary Fund. International Financial Statistics, 1983 Yearbook; and World Bank, Report on World Development, 1984. Washington, 1985.

Despite the world recession and the size of the external debt of the region - which is concentrated in those countries with a higher level of industrialisation - it is reasonable to assume that they will become dynamic markets for data processing services and goods.

Table 3 Principal importing countries for computers in Latin America

Country	Position within the 50 largest importers of computers in the world in 1978	1978 Imports (US$ millions)
Brazil	16	193.7
Mexico	20	160.8
Argentina	24	99.8
Venezuela	26	97.2
Chile	43	26.7
Colombia	47	21.6

Source : Szuprowicz, B. "The World's top 50 computer import markets", in Datamation, January 1981.

This dynamic is not limited to data processing services and goods but extends to the greater part of the specialities of the EC. The pattern of imitative consumption which has been the classical one in the region - at least in the sectors with the higher incomes - is coupled with the increasing differentiation of models and the appearance of new electronic consumer products on the world market, giving an impulse to the growth of this market in the Latin-American countries.

To this is added the replacement of electro-mechanical technologies in capital goods - such as telephone equipment and office machinery - and the penetration of electronics into other production goods such as numerically controlled machine tools or electrical equipment.

The need to modernise the productive apparatus, and the weakness of the capital goods industries in the region creates both the need to incorporate new technologies into the EC and also that of importing these goods and of creating local capacities to produce them.

This dynamism of the electronics markets, combined with the industrial and technological inadequacies commented on in paragraph 1.2.1., has meant that the EC has become a focus of increasing problems for the region, and is also an indicator of its structural weaknesses.

Amongst these problems may be mentioned the external deficit generated by the interchange of elecronics goods, which in some countries and years explains the greater part of the trading deficit, the erosion of the comparative advantages based on cheap labour and the availability of natural resources, and the under-utilisation and high cost of use of electronics capital goods which is the result of the anarchy within the existing stock of data processing equipment together with the unsuitability of the physical and technical infrastructure of the countries in the region as compared with requirements for production goods.

The combination of these problems poses a new "question" which forms part of the "agenda" of the Latin-American States and companies.

However, as with the incorporation of data processing goods major differences may be seen between the countries in the region, and there are also various levels of perception of the "question" of the EC, various orientations in the public policies and a high level of differentiation between the technological and industrial capabilities needed to formulate and to implement policies.

From the point of view of state actions there is a wide gulf between those carried out in Brazil and those undertaken in the other countries. Up until 1981, the year in which the Mexican computer policy was initiated, it could safely be said that Brazil was the only Latin-American country which had taken the decision to create a technological and productive capability in the EC, including micro-electronics[1].

In regard to the existing local capabilities - which to a large extent determine the possibilities open to public policies - the facilities were concentrated in only a very few Latin-American countries. This is shown by

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1. After Jacobson, S. and Sigurdarson, J. "Technological trends and challenges in Electronics", Research Policy Institute, University of Lund, Lund, 1983.

the intrinsic structure of regional external trading. During the eighties Argentina, Brazil and Mexico accounted for 96% of all Latin-American exports of electronics goods, 57% of the total interchange, 50% of the imports and only 40% of the regional trading deficit. Even more significant is the fact that they absorbed practically 95% of the micro-electronics circuits which were imported into the region[1]. This is an index of differential productive and technological level, given that, there being no significant production of integrated circuits, the fact that they are imported indirectly indicates the local capacity for producing goods based on micro-electronics technology.

2. ARGENTINA

2.1. GENERAL OBSERVATIONS

Between 1956 and 1959 the first fully solid-state electronic computer, named CEFIBA, was designed and built in Argentina[2].

In 1975 a company with state capital, the Electronics Division of FATE, launched the first mini-computer to be produced on an industrial scale in the country. As a result this company displaced one of the leading multinationals from the position of market leader, controlling more than 50% of the local market for electronic calculators. FATE uses its own trade-marks, designs and technology; imported components account for less than 20% of the total costs.

In 1983 some 90% of the domestic market for computers and calculators is supplied from outside; imported inputs represent 37% of the production value of the local industry. Of this production value slightly more than three-quarters is represented by printers[3], manufactured by a multinational for export - to its affiliates. In this year the body responsible for data processing policy was the Subsecretariat for Data Processing (Subsecretaría de Informática), amongst the function of which were none linked either directly or indirectly to the development of local productive and technological capabilities.

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1. After Lahera, E. and Nochteff, H. Op. cit.
2. After Lahera, E. FATE y CIFRA: Un estudio de caso en difusión y desarrollo digital en Argentina, Universidad del Salvador, Buenos Aires, 1976.
3. Percentages calculated on information from the National Institute for Statistics and Censuses (INDEC) and from Azpiezu, D., Lahera, E. and Nochteff, H. Comercio Exterior de Electrónica de Argentina: Series Estadísticas 1970-1983, FLACSO, 1984.

These phenomena raise three questions which, in their inter-relationship, characterise the behaviour of the electronics industry in Argentina. Firstly the technological and industrial development of the electronics complex (EC) has been very much less since the middle of the seventies than might have been hoped for, given the resources of the country, at the beginning of the sixties. Secondly that from the middle of the seventies there has been a process of de-industrialisation and technological regression which has been of particular intensity in the case of the electronics industry[1]. Thirdly that two factors are decisive when explaining the expansion of the EC in this quarter-century :

a) the impact of the economic policies in general and of foreign trade in particular, and

b) the absence of policies orientated directly at the generation of industrial and technological capacity in the EC.

The latter has tended to be overcome in 1984 and 1985. For example the National Data Processing Commission (Comisión Nacional de Informática, CNI) was created in February 1984, and in October of that year it submitted a report to the President of the Nation in which it put forward the broad lines of a data processing policy. In September of that year the Chamber of Deputies submitted to the Senate of the Nation a draft law to promote the "Argentinian Communications and Electronic Data Processing Complex" (CIEC).

In early 1985 the Secretary for Industry (SI) began to implement some of the aspects of the policy proposed by the CNI as sanctioned by Resolution SI 44/85 and with reference to the computer industry. The same SI stated that by the middle of the year similar resolutions would be drawn up in the field of industrial electronics and telecommunications.

On the above basis the following sections will deal with :

a) the principal characteristics of the policies which have had an effect on the pattern of development of the sector;

b) the fundamental features of the policies formulated from 1984 onwards and, finally, on their probable future evolution.

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1. See Nochteff, H. Desindustrialización y retroceso technológico en Argentina, 1976-1982. La industria electrónica de consumo, FLACSO - Grupo Editor Latinoamericano, Buenos Aires, 1984.

2.2. PUBLIC POLICIES AND INDUSTRIAL AND TECHNOLOGICAL DEVELOPMENTS UP TO 1983

2.2.1. The isolation and opening-up of the market

Argentinian industrialisation, as a typical process of replacing imports, was structured since the middle of the seventies on a strongly protectionist pattern, sustained by means of a wide range of exchange and tariff restrictions. This protectionist structure particularly affected finished goods and, to a lesser extent, intermediate and capital goods. This was reproduced exactly within the EC, resulting in a configuration of partial isolation in the field of electronic consumer goods as a result of this protectionist framework.

Within this general pattern the market for electronic capital goods remained relatively open to external suppliers and without the State buying policy - the largest purchaser - encouraging local technological and industrial development. The sole and partial exception was the support which was given to the FATE project from the start of the seventies.

This pattern of development was drastically and radically transformed as a product of the economic policy implemented - from 1976 onwards - during the period of military control of government. One of the objects of this was precisely a change in the forms of interlinkage of the Argentinian economy with the international economy. Within this framework there was a generalised opening-up of the goods and money markets. In the first case this was effected by way of three simultaneous mechanisms :

a) a drastic reduction in tariffs,

b) the elimination of extra-tariff restrictions, and

c) a revaluation of the Peso by way of a re-phasing of exchange patterns.

The implications of this in the field of electronics may be summarised as an appreciable reduction in the real costs of imports, reaching 80% in the case of some products[1] which indicates profound changes in the relative price structure between national and imported goods, and a policy of State buying which was quite definitely directed towards purchasing from outside.

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1. Nochteff, H. Op. cit.

2.2.2. Industrial and technological development

The industrial structure generated by the protectionist policies and the developing guidelines showed the following distinct characteristics :

a) The predominance of the production of consumer goods over the production of capital goods. Over the five-year period from 1970 to 1974 the production of the Argentinian electronics industry accounted for US$ 2,234 millions (at 1978 values), and of this total consumer goods accounted for US$ 1,503.4m.

b) The development of a components industry linked with the demand deriving from the consumer goods. In 1974 these accounted for 81% of the local production of components.

c) The predominance of companies with domestic capital, with their own trade marks and technologies, which acquired the greater part of their components from the local industry.

d) The technical and organisational development of the companies and the incorporation of the major innovations in the semiconductors industry (transistors and integrated circuits) resulted in a significant increase in the productivity of the work-force, so leading to a major reduction - in real terms - in the prices of electronic consumer goods.

e) The components industry was basically centred on the production of passive components and in carrying out work on the packaging and wiring of semiconductors, including some integrated circuits. In general a general shift in the technical frontier could be seen from the end of the sixties, both in the progressive replacement of passive components by semiconductors and also in the rising levels of production to the international level and the reduction in labour costs which was facilitated by off-shore deployment.

f) The development of the capital goods production sector presents distinctive characteristics. The multinationals were predominant in telecommunications, with the participation of companies with local capital and their own technology being limited to the minor markets such as radio-communications, broadcasting, medical electronics and electronic measuring and monitoring equipment. In the latter two areas there developed a considerable number of small and medium sized companies with local capital and their own technology, something which constitutes an exceptional phenomenon within the Third World[1].

1. See, e.g., UNCTAD, Electronics in developing countries: Issues in the transfer and development of technology, TD/B/C.6/34, U.N., Geneva, 1978.

The drastic change in economic policy from 1976 onwards resulted in an in-depth modification of the industrial and technological configuration of the EC in Argentina. This was most noticeable and radical in the consumer goods sector, the sector of the greatest relative significance and the one which had been most protected up to that time.

The principal implications of this structural change in the sector may be summarised as follows :

a) Whilst local capital continued to be predominant some 90% of the output was produced with external technology as against a figure of less than 20-25% up to 1976.

b) Every company received practically all the components from the same external supplier which was, at the same time, the owner of the technology.

c) The technical and organisational requirements of the companies tended to be be reduced to the minimum. By receiving both technology and components from the same external supplier the functions of R & D, production engineering and purchasing practically disappeared.

d) The product cycle and the greater part of its costs were determined on an exogenous basis.

e) Any possibilities of adapting the technology to local requirements were lost.

f) There was a significant increase in the demand for imports so that, for equivalent levels of output (in physical units) the electronic consumer goods industry acquired imported inputs to a value of US$ 16 millions in 1974 and US$ 158m in 1980.

g) An in-depth change could be seen in the capital goods sectors, associated not only with the changes in public policies but also with technological replacement of electromechanical techniques by electronics. Unlike what had happened during the electromechanical phase, in a protectionist framework, the State did not legislate for the national integration of some of the supplier companies.

h) Most of the companies which were active in medical or measurement and monitoring electronics specialities abandoned or reduced this activity as a consequence of the sudden withdrawal of effective protection and the shift towards imports in State purchasing.

i) In the area of computing and office machines the productive structure changes radically, in terms of both goods and agents. This merits more detailed consideration. In 1976 production was concentrated in only three companies : I.B.M. (electromechanical printers, 90% of which are intended for intra-company export), Olivetti (calculating machines) and FATE (electronic calculators). The first of these changed their production lines from electro-mechanical to electronic (high-speed serial printers), entrusting the wiring and the provision of mechanical parts to local suppliers whilst importing practically all the electronic components required. The second transferred its manufacturing plant - changes in its multinational strategy - to maintain only an activity which is of little significance in respect of all electronic calculating machines. The third company, FATE, the only one with national capital, postponed its expansion and development programmes from 1976 onwards, finally abandoning all production between 1978 and 1980. It should be emphasized that FATE, with its own trade-mark and technology, had reached a predominant position in the calculator market, had launched its own mini-computer and was exporting. Its development programme - which was followed up to 1975 - included the production of integrated circuits with a high local content.

j) The restructuring of the equipment industry determined the fate of the electronics components industry. Those markets on which the latter depended for growth possibilities (electronic telephones, computing, electronic calculating machines and colour TV) were almost totally supplied by importing or by companies which assembled components imported into the country. The greater part of the companies in the sector abandoned production.

2.2.3. Some influences on the data processing policy initiated in 1984

The process which can be observed between 1976 and 1983, and its structural implications, created strong conditioning influences on the success of the policies implemented since 1984.

The industrial and technological structure of the mid-seventies formed a resource which was suitable for initiating a policy of electronics development in general and of data processing in particular. As pointed out in 2.2.1. this structure revealed serious weaknesses but at the same time it implied a linked industrial and technological system lacking in most developing countries.

Furthermore the majority of these weaknesses were associated with the intrinsic nature of the general protectionist policy, which fundamentally favoured the development of the electronic consumer goods sector, without being accompanied by specific policies to encourage the industrial and technological growth of the Argentinian EC.

This industrial and technological system was, however, broken up by economic policies of a general and non-specific character (except the case of the neglect of means of promotion for FATE).

A clear indicator of the loss of technological and industrial capacity is the drop in the participation of micro-electronic components in the total electronics imports[1]. Between 1973 and 1976 this drop increased from 1.44% to 4.31%, then falling to 0.8%[2] in 1981.

To this drastic reduction in the capacities and levels of technological autonomy must be added the failure to grasp the opportunities offered by the accelerating expansion of the Argentinian computing market (see Table 4).

Table 4 Annual growth of the total number of computers in use

YEAR	TOTAL	Classes 2 to 5[a]		Remainder[b]	
		Number	% change	Number	% change
1977	1040	1040	--	----	--
1978	1320	1320	27	----	--
1979	2987	1982	50	1005	--
1980	5752	2697	36	3055	204
1981	7856	3418	27	4438	45
1982	11575	3919	15	7656	73
1983	23345	4543	16	18298	139

a. Classes 2 to 5 include computers with an estimated price of US$ 60,000 for a typical configuration

b. This heading includes home computers, microcomputers of the "PC" type, word processors and Class 1 equipment with an estimated price of US$ 12,000 for a typical configuration.

Source : Comision Nacional de Informatica, Basic Document, Buenos Aires, October 1984.

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1. Given that the local production is statistically insignificant the dynamism of the importers is a factor which is indicative of the incorporation of micro-circuits in domestic production and, also, of the productive and technological dynamism of the same. Although the incorporation of micro-electronic circuits developed at an accelerating pace throughout the world this same incorporation steadily fell in Argentina from 1976 onwards.

2. See Azpiazu, D., Lahera, E. and Nochteff, H. Op. cit.

The opportunities offered by such a level of growth for the accumulation of capital and the diversion of resources to R & D in the data processing industry were, in this way, lost. The example of FATE showed that such exploitation would be possible, reproducing and amplifying that which was carried out in the first half of the decade in the area of electronic calculating machines.

Finally the development of Argentinian external trading in electronic goods shows that :

a) the policies of the period 1976-1983 substantially reduced the competitive possibilities of local industry and, at the same time, its future "performance";

b) the trading deficit originating in the interchange of electronic goods had a significant negative effect on the Argentinian balance of trade.

In fact the participation of electronic imports was reduced, in total, between the three-year periods 1970/72 and 1975/77 from 4.36% to 3.44%. From that time onwards it steadily increased, reaching 11.8% in the three-year period 1981/83. The incidence of electronics in exports, for their part, showed a slight fall from 1.29% in 1970 to 1.07% in 1983. The overall results are summarised in Table 5.

Table 5 ARGENTINA: Balance of trade in electronics for selected three-year periods (US$ millions at current values and %ges)

THREE-YEAR PERIOD	IMPORTS	EXPORTS	DEFICIT	INTERTRADING DEFICIT %
1970/72	238.3	82.5	155.8	48.6
1981/83	2256.0	318.6	1937.4	75.3

Source : Azpiazu, D., Lahera, E. and Nochteff, H. Op. cit.

2.3. THE ELECTRONICS POLICY OF THE CONSTITUTIONAL GOVERNMENT

2.3.1. Policies proposed by the CNI

As has already been pointed out the CNI sent a report containing a series of policies, with mechanisms for implementing them, to the Executive Power in October 1984.

Policy for industrial development

In the view of the CNI this should embrace the computing, telecommunications, industrial electronics and components industries, concentrating on a few product lines. The selection of these product lines or specific goods should be carried out on the basis of certain characteristics, such as the fact that they should be :

. accessible (in terms of their capital and technology requirements) to companies with a majority national shareholding;

. able to count on expanding markets;

. capable of progressively extending the technological frontier and so of expanding the producer companies to more complex units.

The promotional attractions to be offered should be extended to cover the tariff, financial (credit at preferential rates) and fiscal (reduction of taxes) fields. The beneficiaries - a limited number per product range - should consist exclusively of companies with a majority national shareholding, chosen by public competition. In order to enjoy the benefits to be granted these companies must meet certain requirements in regard to : production and export volumes, the integration of local inputs, technological development, the use of trade-marks, the training of personnel and the nominative nature of their activities. Within this framework direct foreign investment should assume a role of complementarity to local investment in those areas or products which are not within the reach of companies with purely local capital.

Other aspects which are envisaged in the suggestions put forward by the CNI relate to the need for purchasing in the public sector to give preference to those companies selected by these public competitions, to the opening of technological packets and the provision of inputs, the technical standardisation of State buying so as to facilitate greater participation by local industry, and the promotion of "user-supplier-financier" groups for the larger supply contracts.

Policy for software development

The substantive proposals put forward by the CNI may be summarised as follows :

- calling for tenders for carrying out software projects, giving preference to companies with local capital;
- granting financial encouragements and State contracts for locally developed software;
- promoting the assembly of "packets" to link public and private demand with the local supply, together with agreements with other Latin-American countries to cooperate in software development, the training of human resources specialising in the use of Spanish in applications programs, the establishment of a register of software imports and balancing shares in software contracts.

Policy for Research and Development

In the field of R & D the CNI considers that the State should take over some activities which imply higher costs, risks and times to reach completion, together with the tasks of coordination between the various local and Latin-American technology centres with the establishment of a close linkage between these centres and private industry needing these technologies. As one way of improving the linkage between the State R & D structure and private industry the CNI proposes to create a costed system for the transfer of the technology generated in these centres and a system of support for companies in respect of technical aid, information and technological expansion. Similarly the use of trade-mark licences should not be allowed as a mechanism for encouraging the local development of technology but rather support in negotiation of contracts for the transfer of technology and for drawing up a technological "forecast". The priority areas in the R & D field should be : micro-electronics, data processing, automation, robotics and telecommunications.

Other policies

The CNI proposes that the policies set out above should be supplemented by others linked with the training of human resources at secondary, tertiary and post-graduate level, the incorporation of data processing at the various levels and specialities not directly linked with data processing, the regulation of international data transfers (IDT) and the rationalisation of the data processing systems in public Administrations. The CNI also recommends a policy for users directed towards greater market transparency and the creation of information and dissemination mechanisms.

Proposed institutional mechanism

The very nature of the policies as set out above presuppose the intervention of a wide range of State institutions and bodies. For this reason the CNI proposes the creation of a National Data Processing, Telecommunications and Electronics Commission (Comisión Nacional de Informática, Telecomunicaciones y Electrónica, CONITE) which will have as its principal functions : the formulation of sectorial policies, the evaluation of their execution and the coordination and assessment of the State bodies specifically entrusted with the various aspects of these policies (technological, educational, industrial, etc.).

2.3.2. Policy for the industrial promotion of data processing

On 25 January 1985 the Secretary for Industry issued Resolution SI 44/85 which established the mode of competition for the adjudication of promotional benefits for the production of stated data processing goods.

The basic principles behind this mode of competition may be summarised as follows :

. The companies must have a majority (more than 50%) national shareholding; in the case of one of the segments to be promoted, that of small-sized companies, it must be totally national.

. The incentives to be granted will be fundamentally of a fiscal character, involving tax reductions. This reduction will be on a sliding basis, ceasing to apply after the fifth or ninth year according to the tax and/or the geographical location of the plant.

. To these encouragements are added other incentives which are inadequately defined in the text and which have not so far been explained in a precise manner[1].

. The geographical location of the plants is to be considered in such a way that the promotional benefits will only be granted if the capital investments are located in specific zones, as defined in the Resolution.

1. For example in regard to State buying of data processing products the text speaks of ensuring compliance with the Argentinian "Internal buying" laws, but these laws are of a general character and Res. SI 44/85 does not add any specific preference. The same applies to preferential treatment in regard to imports which are mentioned but which are not defined. From conversations with industrialists who have entered the competition the implementation of these preferences is regarded as a precondition for the success of the promotional programme, coupled with the raising of tariffs.

. Both the granting of the incentives (that is to say as a result of the competition) and also the adjustment of these benefits to each successful applicant, are tied to compliance with certain minimal obligations and to the extent to which the companies concerned exceed the obligatory levels. It should be pointed out that in all cases the benefits offered are the maxima which may be granted within the framework of the legislation in force in regard to industrial promotion.

The obligations are related to the type of product, the degree of integration of locally produced parts and components, the production and employment objectives, the development and engineering activities, the level of approximation to the technical frontier, the use of the trade-marks of national companies and the generation of industrial and technological facilities in each segment, in such a way as to generate external economies to other segments and to the rest of the EC.

Resolution SI 44/85 defines eight segments to be promoted. Each segment, designated A to H, consists of various products of which the production is obligatory, those which are not obligatory but desirable and various activities (engineering, integration of parts, quality control and R & D) which are also obligatory. In every case the maximum number of companies which may be promoted in each segment is defined.

In order to compete for the granting of benefits the companies involved must propose the manufacture of the "obligatory products", and those which are abl to propose the manufacture of most of the "desirable products" (with the integration of parts, own technological development, etc.) have the best chances of obtaining a grant.

Table 6 sets out a schematic summary of the principal obligatory systems and equipment, and those which are desirable, in each of these segments. Table 7 explains some of the obligatory objectives relating to the engineering and technological development activities.

Table 6 ARGENTINA The principal systems and products, the production of which is obligatory or desirable by the companies which are to be promoted

SEGMENT	A	B	C	D	E	F	G	H
Number of companies to be promoted	3	2	2	2	4	8	2	2
PRODUCTS and SYSTEMS : O = Obligatory; D = Desirable (see para. 2.3.2.)								
1. Multi-user, multi-area microcomputers (NCR TOWER type)	O	D					D	
2. Single-user professional microcomputers (IBM PC type)	D	O	D	D			D	
3. Personal/home microcomputers (TI 99/4A type)	D	D	O				D	
4. VDU's, keyboards[1]	O	O		O				
5. Printers[1]	O	O		O				
6. Floppy disk drives[1]	O	O		O				
7. Winchester disk drives[1]	O	O		O			O[2]	
8. Adaptors, expansion units and interfaces for 1, 2 and 3	D	D	O					D[2]
9. Other peripherals	D	D	D	D			O[3]	D[4]
10. Hardware for network integration, bank terminals, special terminals, modems, protocol converters, concentrators, intelligent controllers, etc.					D	D[5]		
11. Dedicated function products based on microprocessors					D			
12. Software for specific applications systems based on hardware manufactured by the companies to be promoted					D			
13. Software packets for hardware manufactured by the companies to be promoted	O	D						
14. Professional multi-user systems	D		D	D				
15. Single-user professional systems	D	D						
16. Personal systems						D	O	
17. Large remote EDP systems (design, supply of equipment - 75% of which must be produced by the companies to be promoted - installation, commissioning, maintenance and software development)							D	
18. Services for data communications links (not less than 50% national equipment)								

1. In segments A and B only two of these peripherals are obligatory, the rest being desirable.
2. Different from segments A, B and D.
3. Some of this equipment (not all).
4. It is desirable that these should be produced by segment H or acquired from companies in this segment, or from companies to be promoted in other segments.
5. These refer to developments which introduce "minor innovations". This segment is reserved for small local capital companies.

Source : Own table based on Resolution SI 44/85.

Clearly the principal lines proposed by the CNI in regard to industrial development are made specific by Resolution SI 44/85[1]. As some of the most significant of these we may point out the preference for companies with a majority domestic shareholding, the concentration on a few product lines, the development of companies' own technology, the orientation towards "custom" and "semi-custom" components and selection by public competition with obligations in the productive and technological fields.

Table 7 ARGENTINA Some obligatory technological development and engineering activities for companies to be promoted within the data processing industry.

SEGMENT	A	B	C	D	E	F	G	H
ACTIVITY :								
1. In cases where production is initiated under licence to nationalise the product in not more than five years	X	X	X	X		X		
2. To develop a prototype CPU of the new generation within four years	X	X						
3. To develop a prototype CPU within four years			X					
4. To develop a prototype peripheral within three years (four years in segment D)	X	X		X				
5. To develop own products from scratch						X		
6. To develop two of the obligatory products in three and four years respectively							X	
7. To develop "custom" or "semi-custom" IC's (permitting subcontracting of production to silicon foundries)	X	X	X	X				
8. To use Computer Aided Design (CAD), Computer Aided Manufacturing (CAM) and Computer Aided Engineering (CAE) systems	X	X						
9. To acquire the capability to assemble and make compatible remote processing bank networks and systems							X	

Source : Own table based on Resolution SI 44/85.

1. Resolution SS 170 (dated 15/4/85) has recently been issued which extends the date for applying for the competition and introduces modifications of minor significance.

3. MEXICO

In 1981 Mexico initiated its policy for the development of the data processing industry through its "Development programme for the manufacture of electronic computing systems, central units and peripheral equipment" (in the following text this will be referred to as the "Computer Programme", or CP).

The Computer Programme arose as a response to the general problems of the Mexican economy and to the questions raised by the development of the new data processing technologies. The following paragraphs will describe :

a) the general problem and the legal framework within which the Mexican computing policy operates; and

b) the principal characteristics of the CP.

3.1. PRIOR SITUATION AND THE GENERAL FRAMEWORK OF THE COMPUTER PROGRAMME.

It was in the forties that the Mexican pattern of industrialisation - which up to that time had been a practically spontaneous phenomenon - began to acquire the substantive characteristics of any process for the replacement of imports. Within this model an accelerating rate of growth could be verified, to the extent that in the period from 1940 to 1970 the GDP expanded at a mean cumulative annual rate of 6.5%. During this period some of the principal structural problems of the Mexican economy became aggravated whilst yet others arose, linked with the country's inherent style of development.

During the sixties Mexican public policies began to be directed towards the solving of some of these imbalances, especially under-employment, the growing stangulation caused by the balance of payments and the extensive presence of multinationals in the most dynamic sectors of industry, such as electrical machinery and rubber derivatives.

Between 1965 and 1983 a legal framework was established, the fundamental objectives of which were to increase exports, to provide support to companies with Mexican capital, to control imports, to regulate the transfer of technology and of direct foreign investment (DFI), to increase employment and to encourage decentralisation of the population.

This legal framework was materialised in the National Frontiers Programme (1965), the Foreign Investment Law (1973), the laws on Transfers of Technology and Patents (1972 and 1976) and the Industrial Development Plan (PDI, 1979).

The National Frontiers Programme (Programa Nacional Fronterizo) resulted in the formation of the so-called "assembling" (maquiladora) industry. The programme, directed towards increasing employment and exports, made it possible for companies with foreign capital to import materials free of duty for processing and subsequent re-export. It was implemented in combination with United States tariff arrangements which granted preference to the products emanating from such industries.

In the case of the electronics industry "assembling" was of decisive importance in shaping the Mexican industry. In 1979 the electronics assembling industry employed 65,000 persons as compared with 50,000 in the rest of the Mexican electronics industry, and exported three times as much as the latter[1]. Furthermore it is recognised that it generated neither any technological transfer nor apprenticeship, so creating a high level of dependency on the exterior, and which could only continue to exist for as long as wage costs allowed. This was the result of the growing process of automation of the electronics industry, making it necessary to reduce the relative influence of wages in total costs in order to maintain production in the labour-intensive assembling industry.

For its part the Foreign Investment Law only allowed up to 49% of DFI in the total capital of companies operating in Mexico, reserving some industries such as petrochemicals for companies with national capital. Exceptions to these rules could only be granted in specific cases, except in regard to "assembling", thus permitting the presence of multinationals. The National Commission for Foreign Investment must approve the DFI which is effected within the framework of the respective Law, taking into account the transfer of technology which is involved, the extent to which the financing comes effectively from outside and the impact of the investment on imports, exports and employment.

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1. See Warman, J. Marcos de referencia y opciones de política para el desarrollo de la industria electrónica en México. Comercio Exterior, Vol. 34 No.1, Mexico, January 1984.

The legislation on the Transfer of Technology (TT) requires the registration of every TT contract and prohibits certain agreements and practices, such as payments for the transfer of technologies existing in Mexico, the validity of patents for more than ten years or the use of foreign trade-marks for goods produced in Mexico, unless used in conjunction with trade-marks registered in Mexico.

As has been pointed out this combination of laws should resolve some of the economic problems generated in the process of post-war industrialisation.

The Industrial Development Plan (IDP) takes up these subjects and establishes a combination of incentives for Mexican economic development up to 1990. It also points out the weaknesses of the Mexican economy to which priority attention is to be given, emphasizing :

- the inability of Mexican industry to compete on the world market;
- the excessive concentration of populations, markets and production in only three centres - Mexico City, Guadalajara and Monterrey;
- the lack of vertical integration of production;
- the almost exclusive accent on replacing imports.

The incentives which the IDP establishes are linked with the recognition of this problem. For example the measures for tax reductions are granted on the basis of the geographical location of the investment, the increase in employment and the utilisation of capital goods of domestic origin. Notwithstanding the new incentives the central instruments for the promotion of local industry continue to be tariffs and import controls. From this point of view the IDP proposes that the controls should be progressively lifted, with protection depending basically on the system of tariffs.

3.2. THE MEXICAN ELECTRONICS INDUSTRY[1]

In about 1980 it was recognised that the Mexican electronics industry showed weaknesses which seriously limited its future development and its capability to contribute towards the solution of the economic problems set out in the previous section.

1. Except when specifically included the data and observations in this section exclude the assembling industry.

Firstly the industry was orientated predominantly towards the production of consumer goods (see Table 8) and capital goods involving simple technologies. For its part the components industry directed its production solely towards the partial supplying of the consumer industry.

Table 8 MEXICO : Production of electrical appliances*

SECTOR	US$m	%
Consumer goods	470	44.1
Telecommunications	250	23.5
Computers	200	18.8
Other	145	13.6
TOTAL	1065	100.0

* Not including the assembling industry

Source : Warman, J. Op. cit.

Secondly it was technologically static, with only 0.8% of total costs being allocated to R & D, a very small percentage even for a developing country.

Thirdly it suffered from its inability to export and even to maintain its share of the Mexican market. As may be seen from Table 9 the contribution of local production to apparent consumption rose between 1970 and 1974 but then fell to the point where in 1980 it was actually below the level recorded a decade before.

Table 9 MEXICO : Contribution of electronics production to apparent consumption (as a percentage)

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
%	71	81	73	75	87	83	82	79	81	73	68

Source : Own table based on data from CANIECE (Cámara de Industrias Eléctricas y Electrónicas)

One of the principal negative implications of these weaknesses is the rising external deficit originating in the interchange of electronics products (see Table 10).

Table 10 MEXICO : Trading balance of the electronics industry*

YEAR	IMPORTS	EXPORTS	DEFICIT
1979	861.1	50.3	810.8
1980	1364	163.7	1200.3

* Excluding the assembling industry

Source : Based on Warman, J. Op. cit. and IMF, International Financial Statistics, 1983.

These weaknesses of the Mexican electronics industry are in contrast to the dynamism of the computing market in this country. This factor must be taken into account when explaining the growing interest of the State and of companies in the development of the data processing products industry. As may be seen from Table 11 the growth of the computing market between 1977 and 1982 was 186%, with a strong bias towards microcomputers, similar to that seen at an international level.

Table 11 MEXICO : Growth of the computing market, 1977-1982
(in millions US$ and percentages)

CLASS OF EQUIPMENT	MARKET (in US$m)		% CHANGE
	1977	1982	
. Microcomputers	13.8	55.3	300
. Mini and mainframe computers	23.2	64.2	177
. Peripherals (sold separately)	22.7	51.2	126
. TOTAL	59.7	170.7	186

Source : Van Dam, A. "La informática, recurso crucial" in Revista progreso, Mexico. D.F., September 1984

3.3. THE COMPUTER PROGRAMME (CP)

The CP employs various incentives to promote investment in the computing industry. The first instrument is the partial relief from taxes for those who install or expand computing industries. This incentive depends on the geographical location of the plant and may be increased on the basis of the employment which is generated.

A second incentive relates to preferential prices for energy inputs.

A third promotional instrument arises from the structure of customs tariffs. Given that the CP is directed towards the specific development of the microcomputers industry these are given the maximum tariff protection whilst minicomputers, mainframe computers and components have much lower import duties.

What appears to be a key instrument in the industrial policy is the application of import quotas. Firstly the CP distributes import permits for computers between manufacturers and distributors. In the first year both sectors are given 50% of the total imports. From the second year onwards the share given to manufacturers is increased, the aim of this measure being to promote production by two simultaneous methods :

a) to encourage the distributors to become producers;

b) to give the producers the status of a hegemony on the market, so forming a source of capital accumulation.

Secondly the total imports are linked with the level of production, and this obliges the distributors to sell Mexican products. Thus in the first two years the manufacturers may import up to four times as many computers as they produce. By the fifth year they may only import a volume equal to that which they manufacture. The distributors, for their part, must increase the proportion of Mexican products in their sales. In the first two years 75% of their sales may consist of imported computers. In the third and fourth years this proportion falls to 66%, and from then on they must distribute the same quantity of Mexican units as those which they import.

Another incentive in the Programme is preferential treatment in respect of sales to the State which represent approximately 50% of the demand for computing equipment.

To those instruments which have already been commented on are added others such as preferential financing terms (in respect of rates of interest and the extent of the credit offered), fiscal incentives for technological development and the promotion of close links between companies and research centres.

The CP incentives are subject to certain conditions such as the origin of the capital, the geographical location, the type of product, the integration of local parts and components and exports.

The greater part of these requirements are set out as sectoral specifications in the general legislation referred to in section 3.1.

For example the geographical location of the beneficiaries has to be in accordance with the scheme for priority development zones as set out in the IDP. Similarly the incentives are reserved for companies having at least 51% Mexican capital, in accordance with the Law on Foreign Investments. Companies may only benefit from the incentives if they produce minicomputers or mainframe computers, and always provided that the project has been approved in the manner laid down in the above Law (see Section 3.1.).

The companies must also comply with the requirements regarding the incorporation of local parts, components and technologies. This content is termed the Degree of National Integration (DNI). As an example of the required level Table 12 sets out the required DNI for minicomputers. When calculating the DNI various factors are taken into account such as the value of the local inputs contained in the product and the type of inputs (integrated circuits, sub-assemblies, etc.).

Table 12 MEXICO : Promotion programme - Degree of National Integration

	MINICOMPUTERS		
	1st year	2nd year	3rd year
Mean DNI	30%	35%	35%
Minimum DNI	25%	25%	30%

Source : CP

In addition, and with a view to improving the balance of trade figures, a currency budget is established for each company, taking into account both exports and imports (of parts and equipment) with payments for bonuses, technical aid, etc.

Amongst the other conditions of the CP the requirements in regard to R & D should be emphasized.

Firstly minimum R & D costs are required, and secondly these costs are classified and graded on the basis of their destination (for the development of new systems, software development or personnel training) and the location of the work (own plant, Research Centres, or shared).

Summarising, therefore, both the incentives and the requirements follow the guidelines set out by the general legislation described in 3.1., giving priority to Mexican investment, to positive effects on the balance of payments, the geographical decentralisation of production, local technological development, the integration of the industrial system and employment.

The priority which is assigned to certain objectives of the IDP and the CP is reflected in attitudes such as that of the Mexican Government in regard to IBM. In Januray 1985 the National Commission on Foreign Investments rejected a project for major investments, put forward by IBM, for the production of microcomputers. The Commission considered that the project should not be accepted since it ran counter to the objectives of the Mexican development policy and because it would replace companies with national capital. It also pointed out that there were already two multinationals, Hewlett Packard and Apple, producing this type of equipment in Mexico.

4. BRAZIL

4.1. GENERAL OBSERVATIONS

In the international literature on data processing policies the case of Brazil is frequently cited as a example of the possibilities which this industry offers to recently industrialised countries in regard to the implementation of specific policies designed to develop national technological and industrial potentialities. This is even more so when it takes the form of a strategic problem of giving priority to some actions which would favour the development and consolidation of an industry based on national capital - either private or State - and which involve restricting the field of action of the multinationals.

Many analysts take up an opposite position, seeing such a policy as a clear example of anti-economic forces, given that the enormous investments which are needed lead only to the gradual extension of the technological frontier, to the establishment of an inefficient industry with prices higher than those on the international market, to a lack of technological and organisational progress as found at world level and, summarising the situation, to results which contribute little or nothing to the national economy.

Going beyond these analytical and evaluative judgements it cannot be denied that the policy of Brazil in the data processing field is an essential subject for study by all who are concerned with the electronics problem in countries at a relatively lower stage of development. Within this framework an attempt will be made in the following sections to describe the most important features of this policy and, at the same time, to evaluate its principal repercussions at the industrial and technological levels.

Before doing so, however, it will be necessary to refer to the macro-economic context within which the policy is located.

The accelerating process of industrialisation which could be seen in Brazil from the middle of the sixties - from 1967 to 1973 the industrial GDP rose at a cumulative mean rate of 13.0% per year - cannot be dissociated from implementation of a sustained pattern of development with strong and aggressive state intervention and the instrumentation of a broad range of means for the stimulation of private investment. Within this framework those industries

producing intermediate goods and, to a greater extent, durable consumer and capital goods, constitute the driving sectors behind the process of industrialisation.

Increasing industrial diversification and the deepening level of vertical integration and complementarity of industry cannot be left on one side of the official economic policy which, by its very nature, directs the allocation of resources in such a way as to favour the accelerating growth of industrial activity and the incorporation and dissemination of technical progress. The assigning of levels of priority to the development of those sectors of key importance for the dynamics of the process of industrialisation thus assumes a protagonistic role in official economic strategy. As one of the leading sectors in the future development of any society the data processing industry cannot be marginal in this aggressive state policy.

4.2. PUBLIC POLICIES IN THE AREA OF DATA PROCESSING

4.2.1. Antecedents, first formulations and the scepticism of national investors (1971-1974)

From the middle of the sixties the Brazilian Navy, with the power it could exercise as a result of its participation in the military government installed in 1964, initiated a series of programmes for supporting the local electronics industry, directed principally towards developing prototype equipment which could possibly limit dependence in the military field on foreign suppliers. By the end of the sixties the updating of the Brazilian fleet gave a new and decisive impulse to this objective of increasing autonomy in the electronics field. The need for local services to maintain and repair the newly acquired electronic equipment encouraged this attitude towards ensuring the development of local industry and of technological capabilities, not simply as an objective of "integral national development" but, more fundamentally, as an essential factor in "national security".

On the basis of this historical and institutional situation Decree No. 68.267 of 18 February 1971 created the Special Working Group (Grupo de Trabajo Especial, GTE) which, coordinated by the Ministry for the Navy and with the active participation of the Ministry of Planning, had as its objective "the design, development and construction of a prototype electronic computer for naval operations". The financing of this "Guaranys" project was provided

by the National Bank for Economic Development (BNDE) which granted a credit equivalent to US$ 2 million intended for the development, over a period of two years of the G-10 minicomputer by the Polytechnic School of the University of San Pablo for the hardware and the Catholic Pontifical University of Rio de Janeiro for the software.

At that date the market for computers in Brazil, showing an accelerating rate of expansion, consisted of slightly less than 800 units - more than a quarter of all those in Latin America - with the clear predominance of those supplied by IBM and BURROUGHS (see Table 13).

Table 13 BRAZIL : Total number of computers in operation by supplying company (in physical units and as percentages) 1971

COMPANY	NUMBER	%
IBM	489	64.9
BURROUGHS	125	16.6
UNIVAC	71	9.4
HONEYWELL BULL	50	6.6
NCR	15	2.0
SIEMENS	4	0.5
TOTAL	754	100.0

Source : BARQUIN, R., quoted by Katz, Luciano R., Nationalism and Computer Technology Transfer : The Brazilian Case. Doctorate thesis, MIT, 1981.

In early 1972 the SWG specified the type of company to undertake the local manufacture of minicomputers: a joint venture with equal shareholdings by the State, national private capital and the foreign company providing the technology.

On this basis the national company Equipamientos Electrónicos (E.E.) was chosen, this being a company which had developed various types of electronic equipment, whilst the selection of the foreign associate company required detailed negotiations, given the conditions which were being imposed on it: a minority shareholding, transfer of technology and subsequent advances in this, without any reservations or restrictions, the acceptance of a diversity of suppliers and a definite date for the transfer of ownership of the know-how

to the local joint venture. From the eight proposals received - four of which tacitly implied non-acceptance of the conditions - two were chosen, Ferranti Ltd, an English company which is a traditional supplier to the Navy, and Fujitsu, a Japanese company and the best proposal in the opinion of the Ministry for Planning, and at the same time the decision was taken to form a holding company, Electrónica Digital Brasilera (EDB), subsequently changed to Digibras S.A. under State control[1] and two companies with a shareholding by the BNDE and E.E. Equipamientos Electrónicos with, in the case of Cobra, Ferranti Ltd and, in the case of Brascomp, Fujitsu. In a short time, in the face of its financial inadequacy, the national company (E.E.) had to withdraw from both companies, without it being possible to replace it by any other local capital company. The national investors, unaccustomed to putting their capital into new and advanced sectors, traditionally controlled by the multinationals, were not prepared to work, to the desired extent, with the aggressive, polemic and all too frequently conflicting State intervention.

Within this framework of growing divergencies between the Ministry for Planning and that for the Navy (relating not only to the foreign company to be chosen but also to whether the local development should be orientated exclusively towards the military field or whether it should be extended to cover its civil applications) the former put forward to the Presidency of the Republic a proposal for the creation of CAPRE (Coordinating Body for Electronic Data Processing Activities), inspired by French experience with the First Computing Plan. This, according to the proposal, would have as its basic objective the promotion of the most efficient use of those computers within the ambit of the Public Administrations[2]. This new body was to be chaired by the Minister for Planning and would include representatives from other bodies in the public sector (including, inter alia, the Chief of Staff of the Armed Forces).

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1. BNDE, Petrobras, Telebras and the Federal Data Processing Service (SERPRO).
2. In time this initial objective would be considerably extended, whilst CAPRE would assume an increasingly active role which would be decisive in the area of data processing, including also the direct formulation of the sectorial policy.

Summarising, therefore, after these first years in which the policy to be implemented in the data processing field was sketched out[1], the basic bodies which had regulated sectorial development from the middle of the seventies were :

- . BNDE : encouraging and promoting national private industry in such a way as to attract capital into the sector;
- . CAPRE : responsible for analysing the problems of the sector and for planning;
- . COBRA : responsible for the research and development area;
- . DIGIBRAS S.A. : the State holding company responsible for the development of computers and peripherals by the national industry.

4.2.2. The formulation and specification of the policy in the field of data processing, and its institutionalisation (1975-1978)

From the mid-seventies the accelerating rate of growth of local demand - in the region of 40% a year - and its total dependence on imports, converted the data processing sector into one of the most critical within an economy with a growing external vulnerability, especially from the time of the oil crisis.

As may be seen from Table 14 despite the restrictions imposed in 1975 on all imports (e.g. the prior depositing of the total value of imported goods) the number of computers installed in Brazil still increased in that year by some 37.4%.

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1. Both the First National Development Plan (1972-1974) and also the First Basic Plan for Scientific and Technological Development (1973-1974) made explicit the predetermined guidelines for the strategy which were linked with sectorial development, together with its role at a macro-economic level. Thus in the First National Development Plan, under Industrial Strategy, the necessity of developing a group of new sectors is considered, each with a high technological density and including, inter alia, the electronics industry. The First Basic Plan for Scientific and Technological Development, for its part, includes within the Special Programme for Industrial Technology the development of the micro-computer industry and computing technology by way of an association between the State and national and foreign companies.

Table 14 BRAZIL : Total number of computers installed in 1974-1975 (in physical units and as percentages)

TYPE OF COMPUTER	1974	1975	% increase
Mini-computers	1573	2271	44.4
Small	781	1046	33.9
Medium-sized	289	327	13.1
Large	71	82	15.5
Very large	42	61	45.2
TOTAL	2756	3787	37.4

Source : CAPRE

Already in 1974 external purchases in the sector formed the third largest item in imports and, according to the estimates of CAPRE, involved the disbursement of foreign currency of the order of US$ 200 million in 1976 and US$ 250-300m in 1977.

Within this framework Resolution No.104 of 3.12.1975 of CACEX (Carteira de Cómercio Exterior) laid down that all imports of computers, parts, accessories and components require the prior approval of CAPRE "with the objective of adjusting the volume of imports to the real needs of the internal demand" gave to this body an important instrument of industrial policy and, naturally, a substantial increase in its power of negotiation. This control over imports constituted, to a considerable degree, the basic antecedent or germ of the future policy of "reserved markets" which was implemented from 1977 onwards.

The growing influence of CAPRE in the sector - from the simple body which was to ensure the most efficient use of data processing in the public sector to the body regulating all the imports into the sector - reached its highest level with the promulgation of Decree No. 77.118 (9.2.1976) by which it was restructured and given responsibility for formulating the national policy for data processing, so as to stimulate the creation and development of national companies. So, following a period of five years during which there co-existed various bodies connected with sectorial policy, the formulation of the national data processing policy was, for the first time, explicitly assigned to one specific body.

In this new role the first resolution of CAPRE (01/76, dated 15.7.76) proposed a reserved market for mini- and micro-computers and their peripherals for companies with national capital, so that the national data processing policy "should be orientated in the direction of making viable the control of the initiatives so as to achieve the conditions for the consolidation of the existing units in industry, with total dominion over and control of technology and decision-making in the country". The very largest computers were excluded from this policy since they were, in any case, subject to import control by CAPRE itself.

Early in 1977 (12 January) Resolution 05 of the Council for Economic Development (CDE) provided fundamental institutional support for the policy which CAPRE intended to develop. This resolution also established five priority points to be considered in the evaluation of all those industrial projects in the data processing field :

a) "level of technological openness", giving priority to those industries which are structured in such a way as to be able to have recourse to local engineering when designing and projecting new products and/or production techniques;

b) index of nationalisation, implying giving priority to those firms without links with foreign suppliers and with a high level of local integration in their production;

c) participation in the domestic market which does not promote a high level of concentration of local production;

d) a majority shareholding by national capital; and

e) balance of payments: priority given to those companies which offer a more favourable perspective in regard to external interchanges.

On the basis of these guiding principles, and by its Resolution 01/77 of 1 July 1977 CAPRE set out its policy of "reserved markets" by competition for the local production of mini-computers which will be limited to only those companies which are selected for this.

Of the fifteen proposals which were presented seven were from companies with national capital, six were from multinationals and the remaining two were joint ventures with providers of technology. The two principal multinationals operating on the market (IBM and BURROUGHS) presented themselves for the competition but tacitly ignored the selection criteria established by CAPRE.

As a counterpart they offered a technology transfer in regard to components.

The decision to exclude the multinationals from the most dynamic segments of the data processing market, and the permissive nature of technology transfer subject to the capacity of the local company to absorb external know-how, resulted in the selection of three national companies : Edisa S.A. (with technology from Fujitsu, Japan), Labo Electrónica (Nixdorf, Germany) and Sharp-Inepar-Dataserv (Logabax, France). To these three companies were added Cobra S.A., now with its new pattern of shareholding[1], and SISCO (Sistemas y Computadores) with its own technology.

In the following year, 1978, the first concrete result of the policies which had been implemented during the decade and, more specifically, from the middle of the decade became apparent: this was the commencement of local production of minicomputers on a commercial scale (Cobra '400). Three years later companies with national capital accounted for 85% of the total number of mini-computers installed in the country (see Table 15)

Table 15 BRAZIL : Total number of mini-computers installed, 1981 (in physical units and as percentages)

COMPANY	Number	Percentage
National		
COBRA	1418	52.5
Labo Electrónica	335	12.4
S.I.D. (Sharp-Inepar-Dataserv)	269	10.0
Edisa	180	6.7
SISCO	90	3.3
Sub-Total	2292	85.0
Foreign		
Burroughs	154	5.7
Others	253	9.3
Sub-Total	407	15.0
TOTAL	2699	100.0

Source : Information Bulletins, Special Data Processing Secretariat

1. 39% Treasury, SERPRO, Caja Económica Federal, Banco de Brasil
39% A consortium of eleven local banks
12% BNDE
5% Digibras
5% Ferranti Ltd and E.E. Equipamientos Electrónicos.

The initial scepticism of the national industrialists had already been transformed into active shareholding and an increasing presence in the sector. For example between 1978 and 1983 the number of national companies producing data processing equipment increased from a mere eight firms to about a hundred[1] accounting for 45.6% of the total sales on the domestic market in 1983 (see Table 16).

Table 16 BRAZIL : Changes in sales of data processing equipment (In US$ millions and as percentages)

Year	Local capital companies		Multinationals		TOTAL	
	US$m	%	US$m	%	US$m	%
1979	190	22.9	640	77.1	830	100.0
1980	280	32.5	580	67.5	860	100.0
1981	370	35.6	670	64.4	1040	100.0
1982	640	40.3	950	59.7	1590	100.0
1983	670	45.6	800	54.4	1470	100.0

Source : Information Bulletins, Special Data Processing Secretariat

Up to the end of 1978, and notwithstanding the views of what was up to that time the incipient national industry, the strong pressures exerted by some multinationals resulted in a considerable modifying of the restrictive policies operated against them. Although the multinationals (IBM, Burroughs) controlled the market for the large computers[2], whilst the market for the mini- and micro-computers was reserved for companies with national capital, in the field of medium-sized computers (at that time with RAMs from 64 to 256 kbits memory, and which were not included in the reserved market policy) only one emulative project from SISCO had been approved whilst, for its part, COBRA had limited itself to announcing its possible entry into this range of goods. Within this reference framework the Plenary Council of CAPRE, in a controversial session on 23.11.1978, authorised the local production by IBM of two of the five types of equipment originally proposed (4341 MG-2 and MG-1), with the compromise that the company should export three items of equipment for each one sold on the local market and also that by 1981 a degree of local integration of components of 20% was required; in its proposal the company had restricted this to 11%.

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1. Bastos Tigre, P. Computadores brasileiros, industria, technologia y dependencia. Ed. Campus, Rio de Janeiro, 1984.

2. Recently, in 1980, the French CII-Honeywell Bull company, associated with the local groups Brasilinvest and Pereira Lopes, was integrated into the local production of large computers.

4.2.3. Further examination and the moderation of the data processing policy: the creation of the S.E.I. (1979 to date)

The dissolution of CAPRE (responsible to the Ministry for Planning) and the creation of a Special Data Processing Secretariat (Secretaría Especial de Informática, S.E.I.) as a body responsible to the Council for National Security (consisting of the President of the Republic and all his ministers) implies on the one hand a raising in status, at an institutional level, of the problems of the sector and, on the other and by the nature of the functions assigned to the new body, the extension of its regulatory scope to cover microelectronics, instrumentation and telecommunications equipment.

At a general level of analysis it may be stated that the S.E.I. has deepened and intensified the general lines which characterised the management of CAPRE as the regulating body in the sector. The policy of reserved markets in conjunction with a strict control over imports - and especially in the case of final products - continued as the substantive basis of State policy. In both cases the implicit strategy did not differ substantially from the historical pattern of replacement: the development and consolidation of the industries producing final goods in such a way that a demand for intermediate inputs was generated - in this case components and also peripherals - at a sufficient level to create the necessary conditions for starting their local production.

In this way the national mini-computer industry and, from the time of its sudden emergence in 1980, that for micro-computers[1] made viable the establishment of an important grouping of supplier companies which were complementary in many different areas. In this way there are now more than twenty firms with local capital in the field of peripherals, the majority of which began their activities after 1979. The local manufacture of disk units (Microlab, Elebra Informatica and Multidigit), of magnetic tape units (Conpart, Globus and Microlab), of printers (Globus, Elebra, Digilab and Prologica), of VDU's (Scopus, Cobra, Parks and EBC), of floppy disks (Flexidisk, Elebra and Prologica) and of data processing ancillary units such as modems and concentrators, showed an accelerating rate of growth which was accompanied by a generalised intensification of R & D work. In practically all the cases

1. Local production of micro-computers began in 1980, and this rapidly became the most dynamic pole of the market. By 1982 more than 15,000 units had been installed, practically two-thirds of these coming from three national companies, Cobra, Prologica and Dismac.

the local production of peripherals began on a basis of licensing agreements with foreign companies. However, and in the same way as was seen in the case of mini-computers, local developments tended to differentiate, to an increasing degree, these local products from those originally licenced.

In addition to the various company strategies in the field of R & D - innovative, defensive, imitative or adaptative - in the various fields of data processing, it cannot be doubted that one of the most notable effects of the sectorial policy has been the consolidation of a climate which was propitious for the work of scientific and technical investigation and the development of a significant technological capability. This may be seen quite clearly by noting the relationship between R & D expenditure and sales from the national sector (8.7%, as against 6.1% in the United States) or the percentage of the personnel occupied on such work (15.3% of the total). (See Table 17).

Table 17 Some indicators related to reserach and development work in the data processing industry, 1980. (As percentages)

	R & D expenditure as a percentage of sales	R & D personnel as a percentage of total staff
Companies manufacturing under licence	7.9	14.1
Companies manufacturing on the basis of their own R & D	14.4	17.5
TOTAL	8.7	15.3

Source : Own table, based on information from Bastos Tigre, P. Op. cit.

With the aim of contributing towards the strengthening of this local technological capability the Centro Tecnológico de Informática CTI) was created at the end of 1982 (Decree No. 88.010 of 30.12.1982). This Centre is devoted to the development of products and processes in the fields of micro-electronics, computers, industrial automation and instrumentation.

The industrial and technological policy adopted by the S.E.I. is, in essence, a continuation of that initiated by CAPRE in the second half of the seventies. The policy of a reserved market for micro- and mini-computers and their peripherals - superminis, based on 32-bit microprocessors, were

included in 1983 - and the rigid control of imports by way of quotas, direct inspection and tariffs, continue to be the fundamental instruments of the policy for encouraging industry with local capital. Nevertheless, and as happened with CAPRE in 1978, the strong pressures exerted by various multinationals - either directly or through the governments of their country of origin, at both internal and external levels - were decisive and determinant in respect of some liberalisation, sometimes of an ad hoc kind, in the real and effective implementation of the official policy. For example in August 1980 the S.E.I. approved the local production of small computers by two major multinationals - in principle these were marginal in respect of the reserved market in the corresponding segments :

. Hewlett-Packard, for the manufacture of microprocessors, exclusively for use in technical and scientific applications, with the compromise that the company would not divulge the software needed for its commercial applications; and

. IBM, for the manufacture of its 4331 MG-2 model, on the borderline between minis and superminis, with the compromise that three units would be exported for every two sold on the domestic market (363 and 242 units respectively).

Even when this type of attitude on the part of the multinationals does not involve a revision of the strategic guidelines in the sector it cannot be denied that it implies a certain tempering of the restrictive criteria applied to these companies. The policy cannot be dissociated from the framework imposed by the external vulnerability of the economy and, more specifically, by the ongoing renegotiation of the external debt which exceeds the payment possibilities of Brazil; such a situation favours the exercise of certain external pressures.

5. FINAL CONSIDERATIONS

The similarities which characterise, from a historical perspective, the processes of replacement industrialisation in Argentina, Brazil and Mexico, have not been reproduced in the field of data processing. The industrial and technological development achieved in Brazil reveals a significant distancing from that of the other two countries, to the point where Brazil has now become the supplier of data processing equipment to these same countries.

This growing gap is directly linked to the roles assumed by the various States, not only in regard to the formulation of a deliberated and specific policy for the sector but also in regard to its active participation in the industrial and technological development of the sector.

In broad terms the principal differences which distinguish the experiences of these three countries in regard to their public policies for the sector may be summarised as follows :

. its timetabling : the delayed response in Argentina and Mexico, as compared with that in Brazil; in this area, and fundamentally since the end of the sixties, the dynamics of productive and technological transformations assume a decisive role, conditioning also the real possibilities offered by the public policies;

. the level of macro-economic hierarchisation : the strategic character which the Brazilian State assigned to national development in the field of data processing as one of the activities intended to assume, in the medium and long term, a leading position within the industrial and technological fields, contrasts with a much less precise and aggressive attitude in the other two countries where, historically speaking, the position in this sector had not been regarded as one of the nerve centres in the pattern of capital accumulation in modern societies;

. the presence of the State : as the direct result of the above the forms adopted by the State presence in this sector are substantially different. Whilst in the Brazilian example the State was not limited to favouring and/or encouraging private initiatives but also participated directly in production and technological development in the sector (through companies, universities and specialised research centres) in the other two cases this presence was

limited to operating a range - more or less varied, more or less powerful - of the instruments of economic policy;

. the nature of the legislative framework : the above aspects are reflected in the characteristics shown, in each case, by the legal framework regulating the sector. From this point of view the most obvious contrast may be seen between Brazil and Argentina. In the former there exists a wide and detailed specific legislation; in the latter the legislation forms parts of the regulatory actions and measures contained in current legislation on industrial promotion which, as such, covers all industrial and technological activities.

. the level of permissivity towards the actions of the multinationals : on this subject there are no major differences between Argentina and Mexico - minority shareholdings by foreign capital -whilst this again contrasts with the Brazilian example where the policy of the "reserved market" in certain segments of product impedes shareholding by foreign capital.

Summarising, therefore, those common factors which may be identified in the early stages of the three experiences under analysis (the specific dynamism of the domestic market resulting in increasing bottlenecks in the face of a trading balance in deficit) are not reflected in the same ways in the characteristics assumed by the policies of the different countries; the same applies to the dynamics of industrial and technological development of the sector in each country.

Nevertheless the emergence of a new common element could be transformed, in the very near future, into a decisive factor where the forms adopted by the policies and the productive dynamics of the sector are concerned: this is the structural fragility resulting from the high level of external indebtedness which, whilst it affects all economic activities, tends in this sector to favour the exercise of all types of extranational pressures. The ability shown by the governmental authorities to face up to these growing pressures will be that which, in the final analysis, will define the future shape of data processing policies and the specific industrial and technological structure of the sector. Within this framework the identification of new and creative forms of cooperation and of complementarity - productive, technological and scientific - between these three countries will assume an increasingly decisive role in shaping the future scenarios for data processing in the region.

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